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UNCLASSIFIED - INFORMATION ON SOVIET
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- 1960

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM --

SOVIET-HOC ACTIVITIES

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I. GENERAL

Academician V. Ambartsumyan Awarded Gold Medal by English Society

The Royal Astronomical Society of England awarded its gold medal to Academician V. Ambartsumyan, president of the Academy of Sciences Armenian SSR, for his work in the fields of theoretical and stellar astronomy. ("Academician V. Ambartsumyan Given Gold Medal"; Moscow, Pravda, 14 May 60, p 4)

II. ROCKETS AND ARTIFICIAL EARTH SATELLITES

TASS Reports on the Launching of the Soviet Spaceship

The following dispatch appeared on the front page of Pravda on 16 May 1960 and on the front page of Izvestiya on the following day:

Scientific-research and experimental-design work has been carried on in recent years in the Soviet Union for the preparation of a flight by Man into cosmic space.

The attainments of the Soviet Union in the creation of artificial earth satellites of large weights and dimensions and the successful testing of a powerful rocket-carrier capable of putting a several-ton satellite into a given orbit, have enabled us to proceed to the creation and initial testing of a spaceship for prolonged flights by Man in cosmic space.

On 15 May 1960 the Soviet Union achieved the launching of a spaceship and its placement in an earth satellite orbit. On the basis of data that has been received, the spaceship, in accordance with advance computations, has been put into a nearly circular orbit at a height of about 320 kilometers above the Earth's surface; thereafter it was separated from the last stage of the rocket-carrier. The initial period of revolution for the spaceship was 91 minutes. The inclination of its orbit to the plan of the equator is 65 degrees. The weight of the spaceship without the last stage of the rocket-carrier is 4 tons 540 kilograms. Aboard the spaceship there was an airtight cabin carrying a weight equivalent to that of a man. It also carried all the necessary equipment for a future flight by a man and also various apparatus whose weight, together with the power sources, was 1,477 kg.

The launching was intended for the testing and checking of the systems aboard the spaceship that provide for its safe flight, flight control and return to Earth. It was also to check the necessary conditions for Man in space. This launching has laid the beginning for the complex work of developing dependable spaceships that insure a safe flight into space by Man.

On receipt of the necessary data from the spaceship the airtight cabin weighing about 2.5 tons will be separated from the ship. No provision is made in this launching for the return of the airtight cabin to the Earth; after the cabin has been checked for its reliability of operation and after it has been separated from the spaceship it and the spaceship itself will begin their descent on command from the Earth and will cease to exist on entering the dense layers of the atmosphere.

The spaceship carries a "Signal" radio transmitter operating on a frequency of 19.995 mc with both telegraphic and telephonic modes of transmission.

In addition to the "Signal" transmitter, the spaceship carries special radio apparatus for the transmission to Earth of data on the operation of the instruments it carries and for the precise measurement of elements of the orbit. The powering of the scientific and measuring apparatus of the satellite is accomplished by means of chemical and solar batteries.

The processing of the first data received from the spaceship has shown that the apparatus it carries is operating normally. Ground stations are making regular observations of the spaceship.

The spaceship passed over Moscow at 0611 hours. The Soviet spaceship passed over Paris at 0738 hours Moscow time. It passed over Leningrad at 0743 hours. At 1036 hours Moscow time the spaceship flew over New York.

The spaceship can be observed visually in the vicinity of the city of Vladivostok on 15 May at 2112 hours moving in a southeasterly direction.

The following dispatch appeared on the front page of Sovetskaya Aviatziya on 24 May 1960 in an article headlined "On the Motion of the Soviet Spaceship":

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At 1800 hours Moscow time on 23 May 1960 the Soviet spaceship completed 134 revolutions around the Earth; during this period it has travelled 5.7 million kilometers. The spaceship has now been moving in a new orbit for a period of five days. The airtight cabin, having been separated from the spaceship, is presently moving in an orbit that is close to the orbit of the spaceship.

The data previously announced in respect to the new orbit have been fully confirmed by the results of direct measurements. The period of revolution of the spaceship is 94.25 minutes; the apogee and perigee are 690 and 306.5 km, respectively.

The "Signal" radio transmitter installed on the spaceship, operating on a frequency of 19.995 mc, is continuing to operate normally, transmitting to the Earth information about pressure, temperature, and the operation of the instruments situated aboard the ship.

Valuable data have been received as a result of the processing of the great quantity of telemetric information transmitted from the spaceship. In particular, important new data have been received in respect to the processes connected with the shifting of the spaceship from one orbit to another. These data demonstrate that it is possible to control the motion of satellites.

The telemetric information from the spaceship is still being received and processed. Recently received data indicate that conditions in the cabin are still such as to insure the life activity of Man.

The last stage of the rocket-carrier, continuing its movement in its former orbit, had completed 137 revolutions around the Earth by 1823 hours on 23 May. At the present time, it is therefore possible to observe separately the spaceship, freed of its cabin, and the last stage of the rocket carrier.

On 24 May the spaceship and the last stage of the rocket carrier can be visually observed before sunrise from 50° to 58° N. and after sunset from 60° to 70° S.

("On the Motion of the Soviet Spaceship", Sovetskaya Aviatsiya, 24 May 1960, p. 1)

The following article had appeared on page 2 of Sovetskaya Aviatsiya a few days earlier:

The planned program of research on the flight of the spaceship was terminated on 19 May 1960.

In accordance with the program, an order was given on 19 May at 0252 hours for the activation of the braking apparatus and the separation of the airtight cabin in order to bring the spaceship down from its orbit.

The braking apparatus was activated and the ship was thereby stabilized during the time of operation of the propulsion apparatus. However, as a result of the malfunction of one of the instruments in the orientation system at this time the direction of the braking jet deviated from the computed direction. As a result, instead of a decrease in the velocity of the ship there was some increase and the spaceship moved into a new elliptical orbit lying almost in the former plane, but having a considerably greater apogee.

The separation of the airtight cabin from the spaceship was accomplished; during this time a normal operation of the system of cabin stabilization was recorded.

As a result of the first launching of a spaceship, a series of very important scientific and technical problems was solved.

-- The reliable take-off and flight in space in accordance with a given program was checked for the powerful rocket-carrier; this insures the accurate putting of a spaceship into an orbit close to a circular one.

-- In the process of flight there was achieved a reliable control of the spaceship and its orientation over a period of several days.

-- The received telemetric measurements show that in the course of the entire flight the air conditioning and thermoregulation systems of the ship operated normally and provided conditions such as necessary for the future flight of Man.

-- Communications with the spaceship by telegraphic means were normal. Communication by telephone during relaying of surface station transmissions through apparatus aboard the spaceship was disrupted due to radio noise causing great distortions.

-- Special radio apparatus, designed for the transmission of commands aboard the ship, the control of the flight orbit, and the transmission of telemetric information from aboard the spaceship concerning the systems on the ship, successfully fulfilled its assignment.

-- The operation of the self-orienting solar batteries transpired normally.

-- All the basic apparatus designed for the accomplishment of a descent has been designed properly and can insure the accomplishment of this task.

The received information on the first flight of the spaceship provided important new data for the accomplishment of a future controlled flight by Man into the cosmos and showed the correctness of the basic thesis assumed during the creation of the spaceship. The result of this work enables us to proceed to subsequent stages of testing.

At the present time the spaceship and the airtight cabin situated nearby are moving in an orbit with a period of revolution of 94.25 minutes. The perigee of the orbit is 307 km and the apogee 690 km. The angle of inclination of the orbit to the plane of the equator is 65 degrees.

The last stage of the rocket carrier is continuing its movement along the former orbit.

The radio transmitter "Signal", installed in the spaceship, is continuing to operate normally, transmitting to Earth information about the operation of the systems and instruments.

(Sovetskaya Aviatsiya, 21 May 1960, p. 2)

"Pravda" Reports Spaceship Observed and Photographed Over Tashkent

Tashkent, 16 May. More than 100 photographs of the third artificial earth satellite have been taken by workers at the station for photographic observation of satellites of the Tashkent Astronomical Observatory. And yesterday morning, scarcely having heard the radio report of the launching of the spaceship, the chief of the station, Abduzalyam Latypov, began to make his equipment ready.

The preliminary data received in advance as to the time of the passage of the spaceship over Tashkent made it possible to hope for successful photographs.

The spaceship appeared at 0448 hours, rather high in the sky above the horizon, for a period of four minutes; it was clearly visible. It was successfully photographed and the film was developed. The station workers were delighted when they saw on the film the clear trace of the spaceship amongst the stars.

("Spaceship -- High Above the Horizon", Pravda, 17 May 1960, p. 4)

Soviet Scientists and the Soviet Press Hail Soviet Achievements in Space

The entire world is once again applauding the grandiose victory of Soviet science and technology. A large spaceship has been put into orbit for the first time in history. It weighs 4 tons 540 kilograms, which is three times heavier than the last stage of the third Soviet cosmic rocket. Aboard the ship is an airtight cabin containing a weight equivalent to that of a man and all the equipment needed for future flights by Man into the cosmos.

The beginning has therefore been laid for the practical tests that will precede the flight of Man into universal space.

One involuntarily recalls the witty answer of N. S. Khrushchev in answer to an American correspondent: "When do you plan to shoot a man onto the Moon?". "We do not intend to shoot a man", answered Nikita Sergeyevich, "to shoot is the same as to throw away".

Yes, the Soviet Union, which is alien to the frivolous pursuit of scientific and technical sensations, is approaching the problem of interplanetary flights with all due historic responsibility.

Such flights will be made. But they will be made only when science and technology have insured the complete safety of the traveller and provided for his safe return to Earth.

The first reconnoiterers of interplanetary highways were the Soviet artificial earth satellites and cosmic rockets; it was they that brought us invaluable new information about the immediate surroundings of our Earth. It is sufficient to recall the discovery of the radiation belts around the Earth, the peculiarities of solar radiation, the intensity of cosmic rays, the degree of danger from meteorites, and many other such things. Medical-biological investigations have already been made by using experimental animals -- dogs sent up in cosmic rockets. These dogs "flew" at heights up to 470 km and returned to Earth safely. To be sure, these

flights lasted only 15 to 20 minutes. But in the astonishing experiment in the second satellite with the dog "Layka", it is well known that the animal lived for a whole week. An analysis of the resulting data showed that "Layka" withstood well the difficult conditions of flight in a state of weightlessness.

But we cannot mechanically apply the results of our experiments with animals to Man. Animals do not comprehend where they are flying or why. Man, on the other hand, has reasoning and a consciousness. The state of a man's nervous system is directly reflected in all his physiological functions. That is why a completely new field of knowledge, space medicine, has been so actively developed in recent years.

The basic tasks of space medicine are the study of the influence of cosmic flight on the health and working ability of Man in order that there, in the expanses of the Universe, Man can work safely and with his full energies. The living organism must be protected from the influence of a complex of cosmic rays, Roentgen rays, ultraviolet radiation and corpuscular radiation. We must find means in order that Man may not be hindered by the absence of molecular oxygen, by low barometric pressure, and by excessive cooling or heating. The overloads arising during acceleration or deceleration in flight, and especially the state of weightlessness, are factors of very great importance.

Safeguarding the safety of the cosmonaut requires the proper solution of many technical and medical-biological problems. The most important obstacle, if you please is Man himself -- the "fragility" of his body. Man should have at his disposal such ships and such instruments as will insure his safe return to Earth or rescue under emergency situations. A spaceship entering the dense layers of the atmosphere without a decrease in velocity would be heated to a temperature of 2,000 to 3,000 degrees and this would result in a rapid fusion and disintegration of the ship's body. That is why the matter of the return to Earth truly remains one of the most difficult problems to be solved. It is possible that it will be necessary to decrease the velocity of the ship in the rarefied layers of the atmosphere and over a long segment of the route.

Automation is being used more and more in modern aviation due to increased in speed. Space navigation with velocities on the order of eight or more kilometers per second will require still more automation. Nevertheless automatic apparatus in space will never be able to replace Man completely.

The new achievement of the Soviet people -- the heavy spaceship -- will undoubtedly provide answers to many still unsolved problems involving the survival of Man in space. The flight of this spaceship enters into the history of astronautics as one of the last steps before the penetration of Man into the Universe.

It is important to bear in mind the general purpose of these cosmic flights. One sometimes hears or reads that in the far distant future, when conditions for life on the Earth have become less favorable than they are at the present time (possibly because the Sun will give less heat and light) humanity will migrate to other worlds, closer to the Sun. Unfortunately some persons seriously regard the problem of flights into the cosmos as a preparation for such a future evacuation of humanity to other worlds. Such viewpoints are sheer nonsense. The Earth has always been, is, and always will be the best of world for Man. And this is not because there are no other planets in the Universe suitable for life. There are doubtless a countless number of habitable worlds in the infinite Universe, but the life of Man is most closely and undisturbedly connected with living conditions on the Earth. This is where Man developed, became a rational being, created a magnificent culture and civilization, and travelled the difficult route to the new Socialist organization of society. Man is building Communism over a considerable part of the world and there is no reason for him to change his Mother Earth for any other planet.

Flights into space are not being made to distract people from the implementation of a better life on Earth. No, we will never be "Moon-men" or "Martians". The fact is that the scientists of the Earth have now approached that stage in the development of science when many problems of primary importance can no longer be solved by remaining at the bottom of that ocean of air that surround our planet. We must carry various kinds of scientific apparatus and instruments beyond the limits of the Earth's atmosphere. We have a single purpose -- the discovery of new laws of nature and new secrets of the Earth and sky; this is so Man will be able to better organize his life here on Earth.

Socialist society, victoriously advancing toward Communism, is creating the most favorable conditions for the progress of science. It is stimulating the rapid development of all its disciplines, it is opening up space for the growth of the gifts and talents in which our people so abound.

The Americans have launched 19 artificial earth satellites. But the largest, placed in a polar orbit, weighs only 770 kilograms. An American attempt to launch a 2-ton satellite was a failure.

Another American failure was the unprecedented provocation of the United States, piracy in the air space of the Soviet Union. Incidentally, the Americans are trying to keep secret the data pertaining to the last of their artificial satellites, asserting that they were not launched in accordance with the program of the International Geophysical Year. Now, after the Powers adventure, it is becoming clear what "program" these American "investigations of cosmic space" are being conducted under.

CPYRGHT

Our country has pioneered the way into space for all of humanity and is pursuing exclusively peaceful scientific goals. The time is approaching when we will be able to speak of the cosmic future of humanity -- an inevitable stage in the continuing progress and evolution of human society. The brisk development of astronautics is already setting a course for the penetration of Man into space, for the time being for scientific research. The following aphorism of K. E. Tsiolkovski is being widely quoted: "Our planet is the cradle of reason, but it is impossible to live in a cradle forever".

The mastery of space will occur at a more rapid pace when there is a triumph of peace and friendship between peoples. That is why the coincidence of the launching of the Soviet spaceship and the beginning of the Paris conference of the chiefs of the four great powers is so deeply symbolic. There is every reason to believe, as K. E. Tsiolkovski has said, that "humanity will not remain forever on the Earth, but ... at first will timidly penetrate beyond the limits of the atmosphere and then conquer all of circumsolar space". Whatever be the new discoveries brought to us by the new spaceship, flying on wings created by the labor of the people of Socialism, they will always be evidence of the most magnificent creativity of the human mind.

✓ ("Man Conquers the Cosmos", by I. Shevlyakov (Chief of the Scientific-Methodical Section of Moscow Planetarium), Pravda, 16 May 1960, p. 4)

Reports and Comments on the Spaceship -- Excerpts from the Soviet Press

The following is the substance of comments made by Academician A. Flagonravov:

The tremendous Soviet spaceship is continuing to move in its orbit. We should take special note of the constant increase in the weight of these reconnoiterers of space. This is evidence of the continuing increase in the power of Soviet rocket technology.

This increase in the useful payload of the rockets is continuing to open up new possibilities for the expansion of a program of scientific research.

In a majority of cases, it is true, scientific research in space, with all its complexity, is successfully being accomplished without the direct intervention of Man. It is often necessary to react to external influences with a speed which the sense organs and brain of Man cannot satisfy. In such cases the operation of automated devices is even more perfect than would be the actions of Man. But a flight by Man in space is nevertheless of extraordinarily great importance to science.

The direct intervention of a man will be necessary in all cases which it is impossible to foresee in advance. Flights that are manned will therefore substantially expand our possibilities of knowing the cosmos.

The first questions always asked by foreign reporters is: "When will the Soviet Union send a man into space?". This is because everyone believes that the first traveller in space will be a Soviet citizen aboard a Soviet spaceship.

It is presently difficult to pin down a definite time for the accomplishment of the first travels into space, but the time is not too far off. ("Route into the Cosmos", Academician A. Hlagonravov, Pravda, 17 May 1960, p. 3)

The following are the summarized remarks of Prof. G. Pokrovskiy:

The weight of the payload of satellites and cosmic rockets is an extremely important technical index. But by all criteria the Soviet cosmic rockets far surpass the rockets developed in the United States. Soviet rocket science, technology and industry outstrip the United States, despite the fact that the leading capitalistic groupings in that country are making mad efforts, striving to overtake and outstrip the USSR in the development of space rocketry.

In their research the scientists of the United States have not gone beyond the limits first established in the Soviet Union; moreover, they have been unable to duplicate the solution of the most difficult problems (the delivery of a flag to the Moon and photographing of the far side of the Moon). Now a new stage has begun in the study and mastery of space. Scientific requirements and technical feasibility have led to the need for sending a man into space.

The acceleration imparted to a spaceship by the rocket carrier as it rises from the Earth to put the spaceship into orbit should be relatively small in order not to cause harm or difficulty to the cosmic passenger.

It is an especially difficult problem to provide for the safe return of space travellers to the Earth. Firstly, it is important to provide for the necessary changes in direction and velocity of flight in space; this can be accomplished by the use of an appropriate jet motor. Secondly, by means of one type or another of aerodynamic brakes it is necessary to cut down the velocity of the ship's movement as it enters the denser layers of the atmosphere. The braking should be quite smooth and not cause vibrations or overloads that would be intolerable for man. Thirdly, the inside of the cabin holding the passenger should be protected from the excessive heating caused by the interaction of the spaceship with the surrounding atmosphere on passing through it at high velocities. Fourthly, provision should be made for the descent of the spaceship at a precisely defined point on the globe; this requires unusually precise maneuvering during the descent and approach to the Earth. It is also necessary that the landing be made smoothly, without jolts which could injure the occupant and make the sensitive apparatus inoperative.

Change in velocity during the flight and subsequent maneuvers associated with the landing are accomplished with greater ease and safety the smaller is the weight of the load returning to the Earth. The cabins on the spaceships will be detachable specifically for this reason. Only the cabin will return to Earth, not the entire spaceship.

It is important to protect the cosmonaut from the influence of currents of high-energy particles and short-wave radiation. It is essential that the flight path in the cosmos not pass through zones in which high-energy particles are concentrated. However, those regions are quite safe which lie directly above the denser layers of the atmosphere. The Soviet spaceship is making its flight in this part of cosmic space.

In general, the departure of a manned spaceship into the more distant regions of space can be accomplished only from the polar regions; this makes it possible to escape the influence of the radiation belts situated in the plane of the equator. A cosmic flight by Man should also be made in periods of lessened solar activity when the Sun's surface is not undergoing those powerful outbursts that are accompanied by the emission into space of radiations and currents of high-energy particles that are dangerous to Man.

A period of lessened solar activity is now beginning. Inasmuch as such phenomena are subject to a periodic regularity, studied in detail over a period of decades, we are sure that the period of lessened solar activity will last for the next few years. It should be exploited for the first flights by Man into outer space.

In this period Man should make an intercontinental flight through cosmic space. Such a flight could serve as the beginning of hypersonic transport by means of rockets. Rockets, for example, could cover the route between Europe and Antarctica in one hour.

Flights with a landing on the Moon, and then on Mars and Venus, could probably be accomplished later.
("The Cosmos Awaits Man!", by G. Pokrovskiy, Promyshlenno-Ekonomicheskaya Gazeta, 20 May 1960, p. 4)

The following is the full text of another feature article:

The launching of the new Soviet spaceship, weighing $4\frac{1}{2}$ tons, is of immense significance for the continuing study and peaceful mastery of cosmic space. A satellite of such a size can hold a man and a great number of scientific instruments for the making of various astronomical and geophysical observations; they will give much valuable data about the properties of the space surrounding the Earth and about cosmic bodies.

A total of 2 $\frac{1}{2}$ years have passed since the launching of the first artificial earth satellite. But what immense successes have since been attained by Soviet rocket technology! Used for peaceful purposes, it is assisting people in the mastery of the immense spaces of the Universe and the penetration by the human mind and scientific genius into the infinite depths of the cosmos. It encourages and inspires Man in his struggle for mastery over nature.

Today marks the opening of the conference of heads of states of the four great powers. The reactionary forces of the United States have greeted this conference by sending an air pirate into the peaceful skies of our country for the purpose of espionage. But they failed. The uninvited guest was forced to "land" -- which was not his wish! The imperialists have learned an object lesson and received an important warning for the future.

The Soviet Union, on the other hand, has greeted the summit conference by the launching of a giant spaceship which is making its flight in the interests of the progress of all humanity. The spaceship on its first revolutions around the Earth has already passed over Moscow, Paris, New York and London. This is a symbol of mutual understanding and friendship between nations. Let the voice of reason and progress triumph in the forthcoming negotiations of the chiefs of state! And when they agree on full and universal disarmament, all the successes of modern science and technology will be fully and exclusively directed to peaceful goals, to the advantage of all the people. We can then imagine with what gigantic steps humanity will move to the peaks of science and progress.

("To the Peaks of Knowledge", by A. Mikhaylov (Corresponding Member of the Academy of Sciences of the USSR), Pravda, 16 May 1960, p. 2)

The following are excerpts from an article by Ye. Fedorov, Corresponding Member of the Academy of Sciences of the USSR:

The interplanetary flight of man will be of special significance in the study of the cosmos. The illustrious successes of Soviet rocket technology have made such a flight possible and have made the solution of this problem the order of the day. Immediately after the launching of the first artificial earth satellite a torrent of applications poured into the Academy of Sciences of the USSR and its institutes from enthusiasts offering their services and even their lives for flights into the cosmos. Incidentally, among them were more than a few applications from citizens of foreign countries.

A spaceship of large size and weight is a prime necessity for such a manned flight. It should have apparatus for the renewal of oxygen and for the maintenance of temperature within a given range, a food supply and adaptations making it possible to ingest food and water under conditions of weightlessness. There must be apparatus for dependable two-way radio communications. Man must be reliably protected from overloads while the ship is being put into orbit and during its descent to Earth, as well as from the harmful influence of cosmic radiations.

Change in velocity during the flight and subsequent maneuvers associated with the landing are accomplished with greater ease and safety the smaller is the weight of the load returning to the Earth. The cabins on the spaceships will be detachable specifically for this reason. Only the cabin will return to Earth, not the entire spaceship.

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Much marginal or extraneous material is included and the article, written in sketchy terms for a popular audience, contains nothing to expand our knowledge of Soviet space technology.

("Automatic Apparatus in Space", by Academician V. S. Kulebakin, Sovetskaya Aviatsiya, 20 May 1960, p. 2)

Full Text of an "Izvestiya" Feature Article of May 17

On 15 May the Moscow radio announced to the entire world the news of the new and remarkable victory of Soviet science and technology -- the launching of the world's first spaceship in an earth satellite orbit.

A report from TASS fills us with pride of our great Motherland which steadfastly continues to maintain superiority in the peaceful competition of world science and technology in the investigation of cosmic space.

The still short history of these investigations consists, in essence, of a listing of a series of Soviet victories, each of which is a "first" of its kind.

This new creation of Soviet science and technology is not only characterized by its unprecedented size and weight -- 4 tons 540 kilograms. The mathematical processing of observations made after the first days of revolution of the new space ship have shown the exceptional accuracy of its launching -- the full coincidence between its precomputed and actual orbit. Radio communications are operating reliably; its signals are being reliably received in a great number of countries; the airtightness and the temperature of the cabin are being maintained completely. The cabin is equipped with all the apparatus necessary for the maintenance of the conditions necessary for the life of Man. The ship was supplied with complex apparatus permitting it to be separated from the cabin in response to a radio command from the Earth.

In the present flight of the new giant satellite no provision has been made for the preservation of the airtight cabin during its descent to the Earth -- it will cease to exist on entry into the dense layers of the atmosphere.

Thus, the flight of the new satellite is the most important preparatory step before the last stage in the conquest of space -- the actual flight of Man in the space surrounding our planet. It has now become clear that this great achievement, converting Man's immemorial dream into reality, is virtually at hand.

In the illustrious list of Soviet victories in the mastery of cosmic space there clearly stand out features characterizing our science as an integral part of our entire Soviet form of life. This above all involves strict planning and the following through of individual stages of research.

Each stage introduces new attainments and its results are considered when preparing for new research to follow.

Secondly, there is the extremely close relationship between science and technology -- the results of experimental and theoretical investigations and mathematical computations are rapidly converted into metal, into technical products, in whose manufacture there is a constant working contact between scientists and engineers.

There is still another characteristic feature -- the high degree of Soviet humanism, manifesting itself in the most careful preparation of the decisive stage -- the flight by Man into space. We recall the indicative answer that was given to this question by N. S. Khrushchev in answer to an American correspondent about when the USSR intends to "shoot" a man onto the Moon. "We do not plan to shoot anyone", replied Nikita Sergeyevich... "to shoot is the same as to throw away". Precisely because Soviet science is alien to the spirit of adventurism, this last step will be taken only after the final perfection of all details guaranteeing the complete safety of flight for Man and his safe return to Earth".

The launching of the first spaceship on 15 May was a substantial step in these preparations.

On the eve of the forthcoming long-awaited flight by Man into space it is useful to look around at that which has already been accomplished by biological and medical science and soberly evaluate what still remains to be done in order to insure the full safety of the future pioneers of space.

Is biological and medical science ready to answer the question of the possibility of a flight by Man into space?

Great and complex problems are being answered by a new science that has developed literally in the last few years -- cosmic biology and medicine. This science developed at the meeting point of many scientific and technical disciplines, such as biophysics, biochemistry, physiology, pathology, aviation medicine, geophysics, astrophysics, radiology, aerodynamics, rocket technology, radio electronics, and others. Space medicine is still very new but this lends a special charm to space biology because of its newness -- a source of creative ideas, daring quests and methodical ingenuity for the people devoting themselves to this branch of science.

In the solution of problems associated with the cosmic flight of Man, cosmic medicine proceeds along the proven path of development of medical science as a whole -- through a great preliminary stage of experimentation on animals, carefully conducted by taking into account all the attainments of modern science and technology.

CPYRGHT

Despite its newness, space biology has already developed its specific methods of research. This is because of the radical difference between the conditions for conducting cosmobiological experiments and the experimental conditions for other biological sciences.

In the experiments in cosmic physiology, from the moment when an animal is placed in the airtight compartment of the rocket, the possibility of any participation by the experimenter in the further course of the experiment is completely excluded. Everything must be foreseen in advance, everything insofar as possible should be automatically recorded.

During flight in the upper layers of the atmosphere and beyond its limits, Man will have to deal with a great many factors that are unusual in their intensity or qualitative peculiarities.

Let's enumerate the most important of them.

The most significant is the high degree of rarefaction of the air -- an insignificantly low barometric pressure, the absence of molecular oxygen, and in a certain layer of the atmosphere, high concentrations of ozone. Beyond the limits of the Earth's atmosphere -- zero barometric pressure.

Man is also threatened by various kinds of radiant energy during a flight in space. Above all we should mention the cosmic rays and other forms of ionizing radiation, the short-wave part of the ultraviolet spectrum which is absorbed by the ozone layer around the Earth and which therefore does not reach through to the Earth's surface.

Small complications of living conditions within the cabin of the spaceship introduce sharp changes into the conditions of heat exchange between the organism and the gaseous mixture within the cabin and between the cabin and cosmic space.

The airtightness of the cabin will be threatened by meteorites which move at immense velocities and which therefore possess an immense penetrating capacity.

In the time lapsing between the take-off of the rocket and the moment when it attains its maximum velocity, the organism will be subjected to the influence of extremely considerable positive accelerations. Such considerable accelerations of the reverse sign will be operative at the time of landing on the Earth or on another heavenly body.

A series of changes in the course of many physiological functions will be caused by the influence of prolonged weightlessness.

In respect to the biological influence of some of these factors we already have available completely adequate data, accumulated, in particular,

by the field of aviation physiology. Certain protective measures have been developed. Included among these measures are numerous reliable systems of which cosmic physiology has made use of the principle of airtight cabins and pressurized suits.

The influence of many other factors on the living organism, such as cosmic rays, ultraviolet and corpuscular radiation of the Sun, a prolonged state of weightlessness, and intensive and prolonged accelerations, have still not been adequately studied.

A brief state of weightlessness has been achieved in the course of a parabolic flight aboard rapid aircraft. In its duration it is not in any way comparable to that state which is of interest to cosmic physiology. In respect to the influence of accelerations on the organism, cosmic physiology has accumulated rather considerable data. However, these data are very far from covering all ranges of intensity and duration of action of accelerations necessary for the solution of the problems of cosmic medicine.

Investigations that have been made, in particular, experiments with shooting dogs in rockets to heights of 100-200-450 km; these were begun by Soviet scientists in 1950, and the historic experiment with the flight of the dog "Layka" on the second Soviet artificial earth satellite enabled us to solve part of these problems.

In the experiments with lifting animals in rockets there were also successfully tested various systems of rescuing them in emergencies. Finally, the experiment with "Layka" demonstrated that an animal, without harm to his condition, can exist for a rather long time under conditions of the dynamic weightlessness which penetrates into the apparatus as it makes its motion in orbit around the Earth. To be sure, this experiment requires constant repetition.

We also need experiments with prolonged and careful observation of all the functions of animals returning to the Earth after a prolonged stay on artificial earth satellites. This is necessary in order to precisely establish whether there are any harmful after effects from the action of cosmic rays on the organism. These rays in space are of considerably greater intensity than at the Earth's surface. During the course of such experiments many other problems will be solved as a by-product of the main investigation. Precise solutions to these problems are necessary in order to insure the safety of the first astronauts.

After the technical solution of problems associated with the control of the flight of the cosmic rocket and after safe methods have been developed for its return to Earth, we come to the problem of the flight of the first manned spaceship. We should prepare for this in advance.

The cosmic pilot will be subjected to extremely severe demands: a prolonged stay in an insulated cabin of limited size and the absence of customary surroundings (complete silence, the blackness of the surrounding star-studded space without any depth-sensation, etc.). The pilot must watch the readings of numerous instruments and for this his reactions must be rapid and clear. The accustomed rhythm of life is disrupted (the absence of a change from night to day). All this, if the selection of personnel is not accompanied by well-devised training, can cause changes in the functioning of the nervous system and can even cause psychic derangements.

Problems of the regeneration of air, supplies of food and water and the like, may be regarded as more or less solved for cases of relatively brief cosmic flights. On long flights to distant heavenly bodies, for example, it is physically impossible to establish on shipboard a sufficient supply of food, even in the form of fantastic superconcentrates, or oxygen in cylinders, or water. The only solution to the problem is the development of ways permitting us to transform the spaceship into a kind of microcosm with its own cycle of circulation of elements, with the regeneration of oxygen, the absorption of carbon dioxide, and the creation of nutritional substances by means of photosynthesis.

This is not a problem of the immediate future, but neither is it a matter of the far distant future.

The experience accumulated by scientists enables us to expect that this stage will be successfully overcome in a relatively brief time and medicine and biology will not lag behind technology which is ready to put into the hands of humanity such spaceships as will insure the reliability and safety of the flights.

The first spaceship in the history of humanity is circling over the Earth, making revolution after revolution with the rhythm imparted to it by the will of Soviet scientists and engineers. The signals of the radio transmitters of this ship are being received all over the world. In these signals, however, there is no information about airdromes, rocket bases, and industrial targets of those countries over which our new "starlet" is passing, nor are there recordings of the radar signals of radar stations in those countries. Our spaceship, carrying the flag of peace and scientific progress, is threatening no one, is not violating the sovereignty of any country, and does not encroach on the secrets of any state. It is not necessary to comment on the difference between the peaceful aspirations of the great Socialist power and the provocative escapades of the unrelenting partisans of the cold war.

✓ ("Great Eve", by V. Parin (Active Member of the Academy of Medical Sciences of the USSR), Izvestiya, 17 May 1960, p. 3)

Czechoslovak Publish Space Exploration Schedule

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In a three column "popular science" review of rocket experiments and space flight plans, with the emphasis on the Soviet "spaceship" of 14 May 1960, the author notes that "Soviet space science is developing so rapidly that it is realistic to hope that man's first flight into space will be realized within perhaps one or two years." In conclusion, he publishes the following schedule, noting that "There is every hope that it will be realizable".

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"1961 -- man will circle Earth for several hours or days with the aid of an artificial satellite.

"1962-1963 -- man will circle the Moon; the first space traveller will land on the Moon.

"1965 -- systematic observation of Mars and Venus with the aid of automatic interplanetary stations.

"1970 -- man will circumnavigate Mars and Venus.

"1975 -- the first space travellers will land on Mars and Venus."

("Towards Human Space Flight", by Patrik Marquart, engineer; Bratislava; Uj Szo, 21 May 1960, p. 8)

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Czechoslovak Observatory Receives "Spaceship" Signals

The following caption accompanied a photo of a man in earphones standing before a shortwave radio receiver and a portable tape recorder:

"Workers at the Panska Ves ionospheric observation institute of the Geophysical Institute of the Czechoslovak Scientific Academy learned of the launching of the Soviet spaceship from radio news broadcasts. Miroslav Jiskra, a technical worker at the observatory, was among the first to receive the clearly audible signals of the spaceship. The Panska Ves observatory has again successfully fulfilled its task as in the case of every Soviet sputnik launched so far. In our picture, Miroslav Jiskra records on magnetic tape the signals sent from the Soviet space ship".

(Photo caption; no headline; no signature; Bratislava; Uj Szo, 18 May 1960, p. 1)

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III. METEOROLOGY

The Coagulation Growth of Hailstones

This is a brief summary of a recent 9-page article on the problem of artificially influencing a cumulus congestus cloud cover for the purpose of averting hail. The successful solution of this problem depends to a significant degree on our concepts of the formation and falling of hail.

The present article makes an attempt to compute the coagulation growth of cloud particles -- basic in the process of formation of shower precipitation and hail. These computations were made by taking into account the peculiarities in the development of cumulus and cumulus congestus clouds as we observed them in 1955-1959 on the Alazan and El'brus expeditions. Using these computations a method is proposed for the prediction of hail processes.

Existing theories of the formation of precipitation from cumulus congestus clouds leads to certain conclusions not confirmed in reality. Our investigations show that:

a) in cumulus and cumulus congestus clouds one observes a growth in the velocity of ascending currents (w) with height to some maximum value (w_m) to a level z_1 , after which the velocity begins to drop. The maximum value for the velocity of ascending currents in developing cumulus congestus and thunderstorm clouds, on the basis of data from 18 experiments, does not exceed 27 m/sec; the mean maximum velocity is on an order of 7-8 m/sec (Fig. 1). In cumulus clouds one also observes the same distribution of velocities of ascending current with height.

The value for the mean maximum velocity in cumulus clouds is 3-4 m/sec.

Measurements have shown that the mean level of maximum velocities for the indicated types of clouds in the Alazan Valley and in the El'brus region is situated at an elevation of 2,500-3,500 m from the level of the point of observations (4,500-5,500 m above sea level), that is, in the middle or near-top part of the cloud.

b) Microphysical research conducted with a trap has enabled us to make some qualitative conclusions about the distribution of cloud drops by size, depending on the height above the base of cumulus and cumulus congestus clouds.

In the lower part of the cloud most drops have a radius of 6-10 μ , and there are 200 to 1,500 particles per 1 cm^3 . In the lower part of the cloud there are also "giant" drops with $R \approx 40-60 \mu$. In the middle and near-top part of the cumulus congestus cloud, situated above the zone of maximum vertical velocities, the sizes of the individual drops attain 400-600 μ , while the water content is about $20 \cdot 10^{-6} \text{ g/cm}^3$.

c) Radar investigations of processes of falling of shower and hail precipitation show a fall from one hearth for a period of 10 to 20 minutes. Shower precipitation lasting 40 minutes or more can be caused by the successive passage of several hearths over the given point.

Thus, the formation and falling of shower precipitation and hail is not a prolonged and continuous process.

The formation of hail can be predicted for convective clouds of intramass origin.

A necessary condition for the formation of hail is the development of cloud peaks to the level of natural crystallization (from -12° to -16°).

For the prediction of hail conditions radiosonde data for the atmosphere are used to determine the temperature stratification, the height and thickness of the cloud and the curve of velocities of ascending currents necessary for the determination of the dimensions of hailstones by using equations 10 and 11 (not reproduced here) during fall to the height of the zero isotherm. In computing the final dimensions of the hailstones reaching the Earth's surface, corrections are made for the thawing of hailstones below the zero isotherm in accordance with data in Table 2.

The maximum possible amount of precipitation was computed which can fall from clouds of an intramass origin in dependence on the velocity of the rising currents.

Table 3 shows data characterizing the relationship between the amount of precipitation Q and the maximum velocity of the vertical currents W_M .

The results enable us to study the possibility of influencing cumulus congestus clouds for the purpose of averting hail. As a result of such a review we have come to the conclusion that the only method guaranteeing cessation of the growth of hailstones is the continual crystallization of the entire supercooled part of the cloud. The episodic influence of crystallizing material on the supercooled part of the drops of a developing cumulus congestus cloud whose peak has a temperature of -6° to -12° , can lead to the formation and falling of hail which would not have fallen had the process transpired under natural conditions. It should be noted that due to the impossibility of determining the place of the origin of the hail hearth for the averting of hail we would have to expend a quantity of reagent which exceeds by approximately three orders that which would be expended if the place of formation of the hearth were known. It is necessary to investigate the possibility of action on clouds by the introduction of hygroscopic material into the lower part of the clouds.

Conclusions:

1. The accumulation of large supplies of water in a cloud occurs as a result of a decrease in the velocity of the ascending currents toward the peak of the cloud, as a result of which favorable conditions develop for the cessation of uplift and the accumulation of larger drops.

These drops or graupel increase by means of coagulation with the uprising fine-drop fraction, increasing the water content of the upper part of the cloud.

2. By using the indicated method for the formation of hail and data from radiosonde observations of the atmosphere, it is possible to predict the falling of hail, the final dimensions of the hailstones, and the amount of falling precipitation.

3. The most effective method for combatting hail at the present time is the continual crystallization of the supercooled part of the cloud.

4. The most pressing problems at the present time are those of study of the macroscopic parameters of a cumulus congestus cloud for the purpose of a timely discovery of hail hearths in order that action be taken to influence them.

✓ ("Characteristics of the Coagulation Growth of Hailstones Associated With Change in Velocity of Vertical Currents by Height", by N. Sh. Bibilashvili, V. F. Lapcheva, A. A. Ordshonikidze, and G. K. Sulakvelidze, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya No. 4, 1960, pp. 585-593)

Report on an Airborne Condensation Hygrometer with Automatic Dew Point Recording

A short article by A. M. Gromov of the Institute of Applied Geophysics of the Academy of Sciences of the USSR describes a new aircraft condensation hygrometer with automatic dew point recording.

Figure 1 shows the layout of the instrument. Figure 2 is a photograph and diagram of a part of the unit. Figure 3 is a diagram of the photoelectric system. Figure 4 is the layout of the amplifier and generator. Figure 5 is a general view of the unit with and without its housing. Figure 6 shows samples of oscillograms recorded at the time of flights in the period of development of convection at a height of 100 m (a) and in nascent regions at a height of 1,500 m. The text discusses the figures in some detail.

On the basis of an analysis of the oscillograms we may also conclude that the sensitivity and inertia of the instrument enable us to record fluctuations in the temperature of the dew point with an amplitude of 0.3° and a duration up to 0.5 sec.

("Aircraft Condensation Hygrometer with Automatic Dew Point Recording", by A. M. Gromov, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No. 4, 1960, pp. 620-625)

On the Theory of the Chain Process in the Accumulation of Charges in Thunderheads

The recentmost issue of the Izvestiya of the Academy of Sciences of the USSR carries an article by V. M. Muchnik of the Ukrainian Scientific Research Hydrometeorological Institute. The article, which is not too long, lists 20 references. Nine of these references were written by the author himself; he has written on this subject since at least 1952.

He states that there is reason to believe that there are always large ice particles (hail, graupel) in the thunderclouds of the temperate latitudes. If we take into account the phenomena of electrification in an electrical field occurring during the thawing of ice particles or their collision with drops, it will be possible to get still better results; this is because the degree of electrification during these processes is greater than some assume. In addition, the possibility of the formation during these processes of drops with both signs will enable us to explain the fact of the existence of a mixture of drops of different charges in thundercloud precipitation.

The chain theory of thunderstorm electricity is therefore capable of satisfactorily explaining (qualitatively and quantitatively) those electrical processes occurring in storm clouds.
("On the Theory of the Chain Process of Accumulation of Charges in Thunderstorm Clouds", by V. M. Muchnik, Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No. 4, 1960, pp 626-629)

IV. GEOMAGNETISM

The Earth's Magnetic Field as a Sum of Two Dipole Fields

Figures 1 to 3 accompanying this article are maps of the X, Y and Z components, computed for each 30° of latitude and longitude.

Once again we can make the assumption that the Earth's magnetic field arises as a result of the vortical movement of the highly ionized material in the Earth's core. It can be represented by the sum of the fields of two eccentric dipoles; this is further evidence of the existence of such movements. Inasmuch as the field of any vortical current can be represented by the magnetic dipole, vice versa, the magnetic dipole can be represented by the field of the vortical current.

By considering the Earth's magnetic field to be the result of a vortical current at the surface of the Earth's core, the reason for the displacement of the anomalies of the residual field becomes clear.

When selecting precise parameters for the dipoles, we can pose the question of the legitimacy of the world anomalies, which, not being objectively existing reality, only arise because the dipole (central or eccentric) by which the main Earth's field was computed, does not represent a true picture of movement in the core, but only the mean or total movement which is more precisely approximated by two dipoles.

For different epochs there can be a different combination of dipoles; this means, and this is very important, that the cause of the Earth's main magnetic field and its secular variations is the same, that is, it consists not only of vortical movements of material in the Earth's core, but also the displacement of these vortices.

("The Earth's Magnetic Field as a Sum of Two Dipole Fields", by B. M. Lyakhov (Institute of Terrestrial Magnetism, the Ionosphere, and the Propagation of Radio Waves), Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No. 4, 1960, pp. 601-606)

V. GLACIOLOGY

The Heat Balance of the Fedchenko Glacier

The following is a brief summary of a 10-page article appearing in the most recently received issue of the Izvestiya of the Academy of Sciences of the USSR, Geophysical Series.

The thermal regime of the surface of glaciers, constituting (including the Arctic and Antarctic) a considerable part of the Earth's surface, is a part of the total problem of heat exchange between the Earth's surface and the atmosphere and is one of a series of problems associated with the formation of climate and the thawing of glaciers. The study of the thermal balance of the surfaces of glaciers is of great significance for the national economy of areas whose rivers are fed by glaciers, in particular, for Central Asia.

The study of the thermal balance was part of the work of the IGY expedition of the Academy of Sciences of the Uzbek SSR to the Fedchenko Glacier -- the largest valley glacier on the globe.

Figure 1 is a full-page map of the Fedchenko Glacier and the headwaters of the Tarymas, Yazgulem and Vanch Rivers (taken from Beletskiy's book "Mount Stalin").

The working area in which thermal balance was measured was situated in the firn area of the glacier at an elevation of 5,000 m above sea level, at the point where the Vitkovskiy Glacier flows into the Fedchenko Glacier; the latter is 2.5 km wide at this point. The surface of the glacier in this part is level, very gently undulating, and without open crevasses. The surface has about a 2° slope.

Figure 2 shows the diurnal march of averaged profiles of wind velocity. Figure 3 is a graph of the recurrence of wind velocity at a height of one meter (a) and the diurnal march of the mean velocity of the wind at a height of one meter (b). Figure 4 shows types of temperature profile. Figure 5 shows the diurnal march of the mean temperature profile. Figure 6 shows the mean march of the mean profile for specific humidity. Figure 7 is a graph of the mean diurnal march of the aforementioned elements of radiation for three groups of cloud cover. Figure 8 is the mean diurnal march of the radiation balance B for three groups of cloud cover. Figure 9 is the mean diurnal march of turbulent heat flow and the current of heat passing into the snow. Figure 10 shows the mean diurnal march of the flow of water vapor from the surface of the glacier. The text, of course, describes the research procedures and instruments in great detail and provides an interpretation of the graphical material. This paper is a thoroughly detailed and documented study.

It is found that the main part of the heat received by the surface of the glacier is expended on evaporation, while a lesser part is expended on thawing and an insignificant part goes into the ice layer by means of thermal conductivity. The glacial material in the firn region therefore "prefers to evaporate". As a result, the amount of material thawing proves to be relatively small.

This means that if the evaporation were small, the amount of thawing material would be several times greater. However, the larger part of the heat goes into evaporation, as a result of which the thawing is retarded. The amount of evaporating material is not great due to the fact that the heat of evaporation for the snow is almost 10 times greater than the heat of thawing.

("The Thermal Balance of the Fedchenko Glacier", by A. B. Kazanskiy (Institute of Physics of the Atmosphere, Academy of Sciences of the USSR) and V. N. Kolesnikova (Institute of Mathematics of the Academy of Sciences of the Uzbek SSR), Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No. 4, 1960, pp. 575-584)

VI. SEISMOLOGY

Report on the Seismic Station "Yerevan"

The following is a full translation of a brief article recently appearing in the Promyshlenno-Ekonomicheskaya Gazeta:

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The seismic station "Yerevan" of the Institute of Physics of the Earth of the Academy of Sciences of the USSR is situated in the university village of the capital of Armenia in a small one-floor house. In an insulated cellar room of this house there are extremely sensitive instruments -- seismographs -- mounted on concrete pedestals.

The seismic station "Yerevan" has close connections with many stations in the Soviet Union, Great Britain, Italy, Hungary, Rumania, Czechoslovakia, and other foreign countries and is mutually exchanging scientific information with them. This cooperation on the part of scientists helps a more precise study of earthquake foci. And there are many of these on our Earth. In 1959 the seismic station "Yerevan" recorded 563 earthquakes, of which 155 were local and nearby, within a radius up to 800 km.

At 1429 hours Greenwich time on 15 September 1959 a strong earthquake occurred in the vicinity of the Pacific Ocean. Its epicenter was situated at a distance of 13,700 km from the station. The displacement of the soil at Yerevan was 45 microns. This year the station also recorded the Agadir earthquake in Morocco.

At 1355 hours 03 seconds local time on 18 April 1960 the station seismograph sensed a vertical subsurface shock near Yerevan with an intensity of 4. It recurred 27 minutes later and on the following day.

The "behaviour" of our planet is observed from day to day in Armenia by seismic stations in Yerevan, Goris, Leninakan, and Stepanavan. Plans call for the expansion of this net. The new seismic stations will be established in Basargechar, Dzhamuk and Idzhevan.

("The Seismic Station 'Yerevan'", by A. Shkulev, Promyshlenno-Ekonomicheskaya Gazeta, 18 May 1960, p. 4)

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